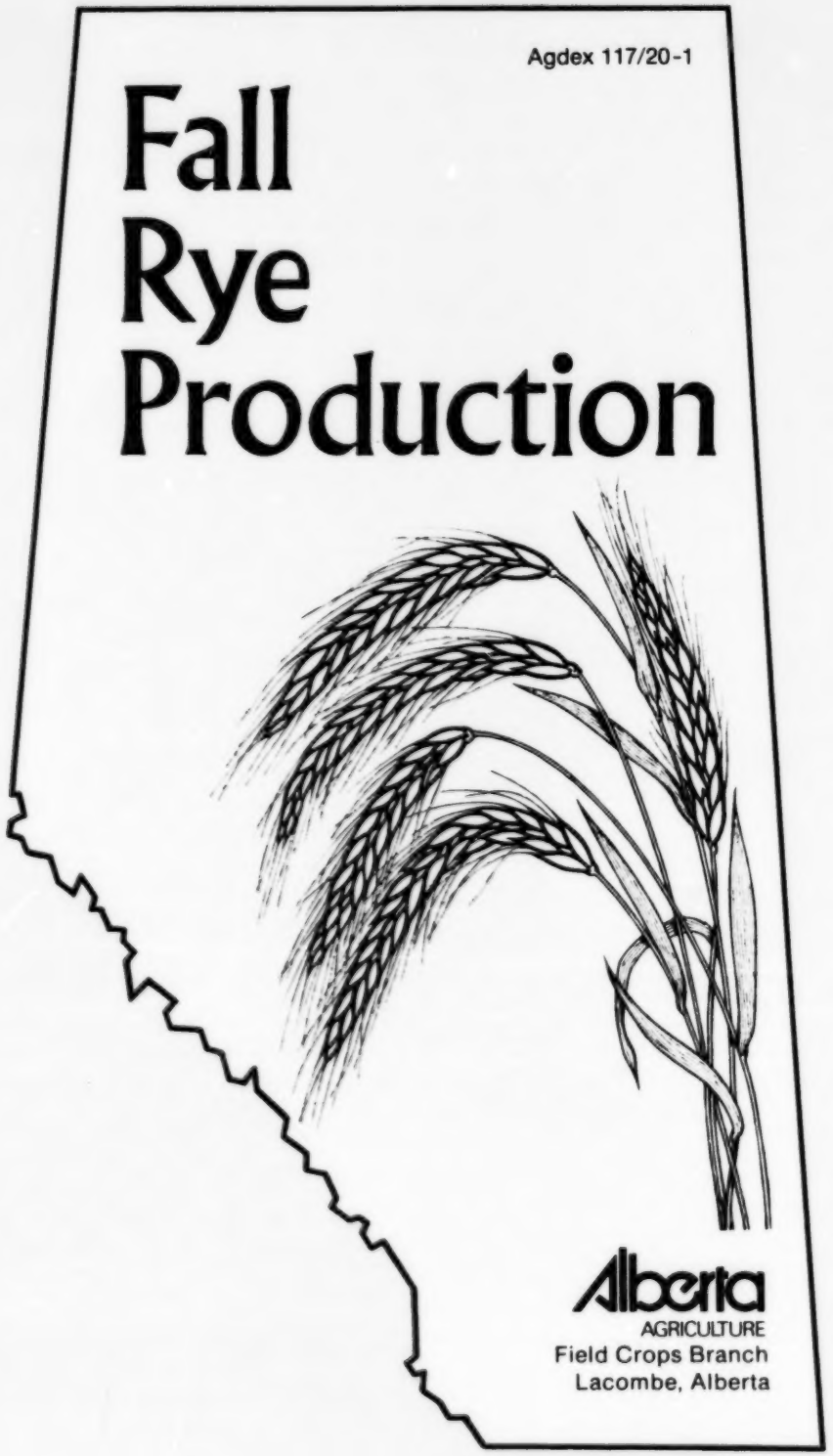
Agdex 117/20-1

Fall Rye Production



Alberta
AGRICULTURE
Field Crops Branch
Lacombe, Alberta

88-05109/

Copies of this publication may be obtained from:

Print Media Branch
Alberta Agriculture
7000 - 113 street
Edmonton, Alberta, T6H 5T6
OR
Alberta Agriculture's district offices

1988 02 3M

ACKNOWLEDGEMENTS

The author wishes to express a sincere thank you to Walter Yarish, Tim Ferguson, Ieuan Evans, Mike Dolinski, Doug Penney, J. Thomas, Don Salmon, Bob Nelson, Grant McLeod, Keith Briggs, Dave McAndrew, Myron Bjorge, Bob Wroe, Russel Horvey, Alan Toly, Bob Wolfe, Blair Shaw, Bill Chapman, Wayne Jackson, Larry Welsh, Ellis Treffry, Mike Rudakewich and Lu Piening for their constructive criticism in reviewing and improving this manual.

A special thanks you to Arvid Aasen who wrote, with the help of Ken Lopetinsky, Vern Baron, Ellis Treffry and Myron Bjorge the Pasture, hay and silage section.

Murray B. McLelland
Supervisor, Cereal Crops
Alberta Agriculture
Field Crops Branch
Lacombe, Albert T0C 1S0

FALL RYE PRODUCTION

Table of Contents

Advantages 1

Disadvantages 1

Adaptation 1

Quality 2

Seedbed preparation 2

Seed selection 2

Time of seeding 3

Depth of seeding 3

Seeding rate 4

Fertility 4

Winter plant survival 4

Weed control 5

Insect control 6

Diseases 6

Harvesting and storage 7

Pasture, hay and silage 7

Fall seeding for pasture 8

Spring seeding for pasture 9

Interseeding 9

Double cropping 10

Hay and silage 10

Grazing and feeding problems 10

Feeding rye grain to livestock 10

Appendix 1 12

Fall Rye Production in Alberta

When deciding to grow a particular crop, an assessment of its relative advantages and disadvantages can be helpful.

Fall (winter) rye's advantages are:

- It grows well on light, sandy, erosion-prone land although it does respond to better land and good fertility. It has good drought tolerance.
- Its straw decomposes more slowly than other cereal straw, further contributing to holding soil that is prone to erosion. Its extensive rooting system also contributes a large amount of organic matter.
- It is much less subject to winterkill than winter wheat, although winter damage can still occur even in southern Alberta.
- It allows a spread in labor and machinery use since it reduces the spring workload and permits earlier grain harvest.
- It makes use of late summer, fall and early spring moisture that might be in short supply for spring sown crops.
- One planting can be used for spring to fall grazing and early spring pasture, then left for grain harvest that summer. However, winter kill and grain yield reduction are to be expected with such a system (this will be discussed more completely later).
- As it matures early it may avoid late summer drought and fall frost.
- Weed control costs are reduced and often eliminated because of fall rye's excellent ability to compete.
- Fall rye outyields spring-sown rye by about 35 per cent. Commercial yields of 50-60 bushels per acre have been reported under good management.

The disadvantages of fall (winter) rye are:

- Even though fall rye is hardier than winter wheat, its winter survival cannot be guaranteed.
- There is a limited market and market potential for fall rye and usually a low grain price.
- It has a weedy nature. Volunteer fall rye will usually appear for two to three years after a crop has been grown.
- It heads in June when the occasional late spring frost may cause damage to the head and reduce yields. Rye yield can be severely reduced by drought stress at heading time which occurs quite often in southern Alberta.
- Seed germination drops rapidly when stored longer than a year.
- Fall rye is very susceptible to ergot which is very toxic to man and animal. Rye's susceptibility to ergot provides a high inoculum level for cereal crops that follow it.

Adaptation

Fall rye is the most productive of the cereal grain crops under conditions of low temperature, low fertility and drought; however, rye does well when fertilized and on practically all soil types. Because of its fall establishment and cold tolerance it can be used effectively in the control of wind erosion on light, sandy soils during fall, winter and early spring.

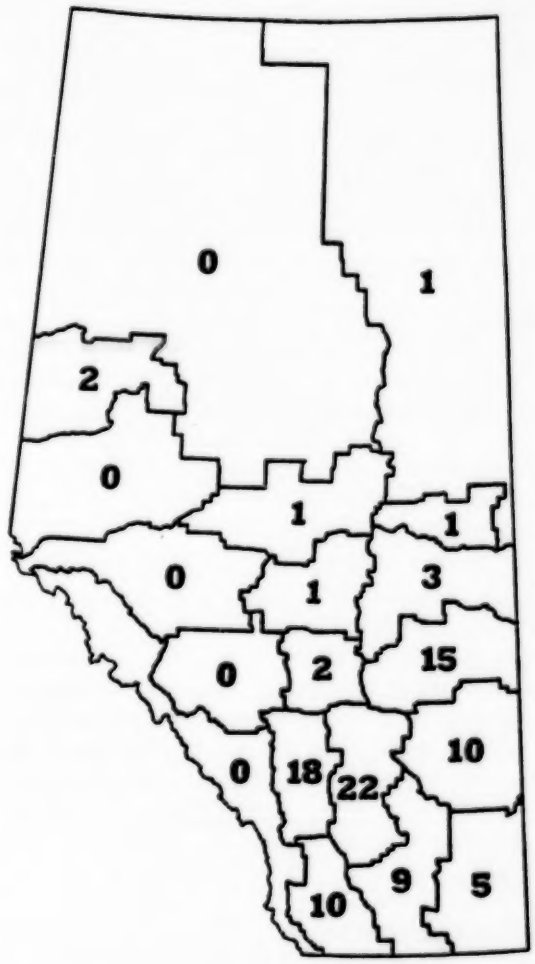


Figure 1. Map shows percentage of total provincial fall rye acres by census district. Total number of acres in 1987 was 168,790.

Fall rye is grown mainly in southern Alberta, but can be grown more widely than winter wheat because of its greater winter hardiness. Figure 1 shows the relative distribution of fall rye production in Alberta averaging a total of 250,000 acres between 1975 - 1985. Yield in this same period averaged 30.6 bu/ac.

Fall rye can tolerate acid soils better than wheat, barley, or canola (Table 1). However, it is not tolerant of saline, wet, or poorly drained soils.

Table 1 — ACIDITY TOLERANCE OF VARIOUS CROPS

	pH
Alfalfa, sugar beets	6.5
Barley, red clover	6.0
Canola, wheat, corn	5.5
Potatoes, rye	5.0
Cranberries, oats	4.5

Fall rye is used extensively for pasture and forage. In many cases fall rye is left to produce a grain crop after providing pasture, thereby giving the farmer two crops from one planting. See "Pasture, Hay and Silage" section for details.

Quality

Quality in grain and oilseed crops is related to the physical and biochemical status of the grain with respect to certain characteristics. These characteristics may be affected to a greater or lesser degree by the variety grown and the environment in which it is grown.

In Canada the only quality factors applied to rye grain are those in the grading system, specifically test weight, degree of soundness, ergot levels, and foreign materials. Quality as it relates to end use of the rye grain, i.e., breadmaking, livestock feeding and distilling, is virtually undefined. The distilling industry uses the standards of the grading system and they require #2 C.W. or better.

Pasture, forage and feeding grain to livestock are discussed in subsequent sections of this publication.

Seedbed preparation

Like other cereal crops, fall rye will respond to a properly prepared seedbed. A good seedbed should be weed, disease and insect free, firm, smooth, moist, warm and with appropriate fertility.

Since most of the fall rye is grown on light textured soils that are subject to wind erosion, preseeding tillage should be kept to a minimum. Use implements that will preserve the previous crop residue to aid in erosion control and to maximize snow trapping. Substituting herbicides for cultivation and seeding without preseeding tillage (minimum to zero till) are other practical considerations. Highest yields of fall rye occur when planted on summerfallow, however, winterkill is more likely to occur. In areas subject to winterkill, seed fall rye into the standing stubble of a spring-seeded crop. The stubble helps trap insulating snow protecting young plants from severe winter weather. Under dry or firm soil conditions, seeding with a hoe press drill is recommended because more even penetration and less drying of the soil usually occurs. Growing rye repeatedly on the same land increases the chance of ergot infection. Rotation with less susceptible crops (flax, canola, barley, oats, wheat etc.) is recommended.

Perennial weeds, especially downy brome and quack grass, must be controlled prior to seeding fall rye. Winter annuals can be controlled with a fall herbicide application. Spring annual weeds, including wild oats, are rarely a problem because of rye's strongly competitive nature.

Seed selection

Fall rye seed should be thoroughly cleaned to remove weed seeds, foreign material, including ergot and cracked kernels. Ergot bodies must be removed to prevent re-infestation of fields. Using pedigreed seed ensures high quality.

There are no ergot resistant rye varieties. The only practical control is to sow clean, year-old seed on land that hasn't grown rye for at least a year. Mowing roadside and headland grass prior to seed set will reduce or eliminate this major source of ergot reinfestation. See *Diseases of Wheat* Agdex 112/632-1 for ergot control.

Improved varieties of fall rye are constantly emerging from research stations. Variety selection may be aided by consulting the annual publication *Varieties of Cereal and Oilseed Crops for Alberta* Agdex 100/32. Current varieties are described in Appendix 1.

Fall rye grain may be used as seed the same fall in which it is harvested provided ergot is not a problem, as after-ripening requirements are satisfied through the swathing, drying and harvesting period. Research has shown fall rye swathed at 40-45 per cent moisture, allowed to dry for 8 days

and then planted, had an 87 per cent emergence. The time between swathing and planting rye usually exceeds this eight day interval.

All fall rye varieties should be treated with a systemic seed treatment to protect the seed and seedling from rots and smuts. Rye tends to be more susceptible to stem smut and seed and seedling rots than other cereals.

A dual systemic seed treatment (contains an insecticide as well as a systemic fungicide) should be used when planting rye on freshly broken land or when wireworms are known to be a problem. Research across western Canada has shown a yield increase of about 4.3 bushels per acre from seed treatment on average, and under some conditions seed treatment has doubled the yield.

Time of seeding

The optimum seeding dates for fall rye in southern and central Alberta are September 1 to 15, with these dates regressing to August 15 to September 1 as one moves northward or to higher elevations. For fall pasture the optimum seeding time is mid-August.

Seeding fall rye too early usually results in reduced grain yield and lower 1000 kernel weight. Later seeding usually results in a yield reduction, delayed heading, later maturity, reduced plant height and lower bushel weight.

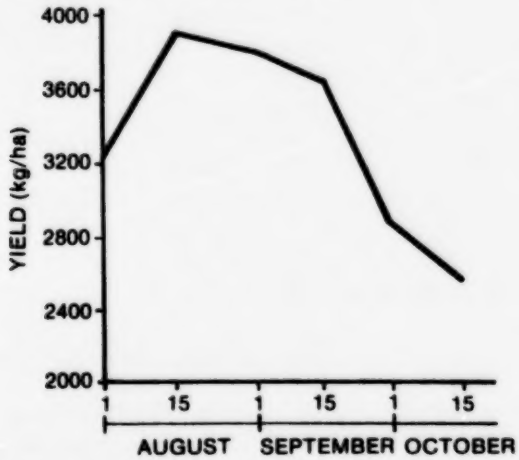


Figure 2. Influence of date of seeding on yield of rye produced on summer fallow (mean of five trials) Source: Crop Dev't. Center, U of S, Saskatoon.

Generally it is necessary for the crop to grow 4 - 6 weeks before the onset of vernalization and cold hardening conditions (daytime temperatures below +10°C and decreasing day length). The top growth should be 3 to 4 inches high.

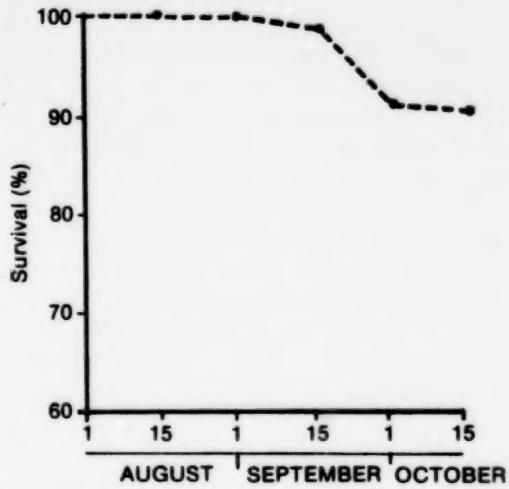


Figure 3. Influence of date of seeding on percent winter survival of rye grown in north-central Saskatchewan. Source: Crop Dev't. Center, U of S, Saskatoon.

Do not delay planting because of grasshoppers. Grasshoppers feed mainly on the margins of the field. Delaying seeding may result in a better crop in these areas, but may jeopardize the whole crop in an extremely cold winter when maximum cold hardening is needed. What is gained through reduced grasshopper damage is usually lost in reduced yields caused by less cold tolerance.

Rye will germinate at lower moisture levels than most cereals. Occasionally surface moisture conditions may be unsuitable for germination around the recommended seeding date. Under such conditions the problem is one of deciding whether or not to delay seeding. No definite answer can be offered to this problem, but most areas of the prairies do receive sufficient moisture during the month of September to germinate rye. It can't germinate unless it's in the ground ready to utilize the September rain.

In studies at Saskatoon, May and June seedings almost invariably completely winterkilled; July seedings were severely damaged. Seedings made in late August or early September came through the best and when the mid-afternoon soil temperature at seeding depth had cooled to about 18°C.

Depth of seeding

Seed fall rye shallow, preferably 1 - 1.5 inches into a firm moist seedbed. Research has shown that fall rye sown at a 1 inch depth had twice the emergence of that sown at 2 inches and that shallow seeded fall rye had greater winter hardiness.

When seeding shallow, the previous crops residue will have a greater tendency to interfere with good seed-soil contact being achieved. Make sure seed-soil contact occurs. Packer wheels greatly enhance the establishment and winter hardening of the crop.

When seeding into untilled stubble fields, obtaining adequate drill penetration and furrow fill are often problems because of the dry packed fall soil conditions. Hoe drills and minimum tillage drills provide the most positive penetration in this type of seedbed, and give the best assurance of good seed-soil contact through furrow closure with packed soil. It should be noted that soil moisture in stubble fields rarely improves with depth, so there is little to be gained by seeding deeper than the minimum required to give good coverage of the seed with packed soil.

When seeding on summerfallow, extra care should be taken to obtain a firm seedbed to facilitate shallow seed placement into moist soil and to prevent soil erosion by wind.

Seeding rate

Fall rye intended as a grain crop should be sown at 55 - 60 lb/acre (1 bu/acre). Fall rye planted for late fall or early spring pasture may be sown at a heavier rate of 55 - 110 lb/acre (1 - 2 bu/acre). The higher seeding rates are used for varieties with a larger kernel size, like Kodiak, Musketeer and Prima, and lower rates for smaller seeded varieties like Cougar, Puma and Frontier. The seeding rate varies not only with the seed size (grams per 1000 kernels) but with the germination percentage of the seed and general seedbed conditions. A target of 20 to 24 live healthy plants per square foot is adequate for maximum grain yield. The following example shows how to calculate seeding rate in pounds per acre of fall rye with a 93 per cent germination rate, 27 grams per 1000 kernel weight and a seedbed emergence mortality rate of 3 per cent. Target plant population is 20 plants per square foot.

Adjusting for germination (93%) and 3% mortality = $\frac{20 \text{ plants}}{\text{sq ft}} \times \frac{1}{(.93 - .03)}$ = 22 kernels need to be sown per square foot to get 20 live plants.

Then:

$\frac{22 \text{ kernels}}{1 \text{ sq ft}} \times \frac{27 \text{ g}}{1000 \text{ kernels}} \times \frac{1 \text{ lb}^*}{454 \text{g}} \times \frac{43560 \text{ sq ft}}{\text{ac}} = 57$ lb/ac is the seeding rate needed.

* 1 pound equals 454 grams.

Fertility

Fertilizer should be applied according to soil test results. Fall rye responds well to adequate phosphorus and to higher levels of nitrogen as compared with hard red spring wheat.

In the absence of soil test results consult the *Alberta Fertilizer Guide*, Agdex 541-1 for general information applicable to your area.

Phosphorous should be placed with the seed or banded prior to seeding. Typical application rates with the seed range from 20 to 35 lb/ac of P_2O_5 to a maximum safe rate of 50 lb/ac. Nitrogen to a maximum of 40 lb N per acre of ammonium nitrate (34-0-0) or 25 lb N per acre of urea (46-0-0) can be placed with the seed, if moisture is good. If soil moisture is marginal for germination, high rates of fertilizer should not be placed with the seed. Both nitrogen and phosphorous can be banded prior to seeding but care should be taken to avoid loss of seedbed moisture and protective crop residue. Nitrogen can also be broadcast in early spring when winter survival, spring conditions, and crop outlook can be used to adjust the rate of application. Use ammonium nitrate for spring broadcasting because it is less likely to volatilize (vaporize into the air) when surface applied.

Possible disadvantages of spring application are:

- weather conditions prevent timely application
- nitrogen may be trapped on the soil surface owing to lack of moisture
- requires valuable spring working time
- fertilizer may be restricted to ammonium nitrate as a source of nitrogen versus lower priced and more readily available urea or anhydrous ammonia.

Winter plant survival

There is no magical number of live plants that determines whether one should leave a partially winterkilled stand for grain production or not, as many production factors have to be considered. For example, if the field is situated in a normally dry area of Alberta, one would tend to keep a stand with fewer live plants than if the field were in an area that traditionally had adequate spring moisture. In a dry area, by the time the field is cultivated once or twice to kill the fall rye and prepare a new seedbed, and the land tilled again during the seeding operation, the seedbed would likely become so dry that very poor germination would result. Unless

timely rains occur, the yield would be as poor or worse than if the light stand of fall rye were left.

Fall rye has a very good tillering ability which helps compensate for quite wide variations in plant population densities. As a rough rule of thumb, in southern Alberta five to six live plants per square foot, and seven to eight in central and northern Alberta, are adequate to justify leaving the stand. The ideal plant population for both north and south is about 20 to 24 live plants per square foot.

To determine the number of live plants in the spring, wait one or two weeks after growth has begun and then dig up a few plants and examine them for new root growth from the crown. The new roots are pure white and thicker than the roots formed the previous fall. If new spring root growth is present, even though the leaves are dead, the plant will recover. In some cases, new leaf growth from the crown will be seen but no new root growth. A plant in this condition will likely die as soon as it uses up the food reserve stored in the crown.

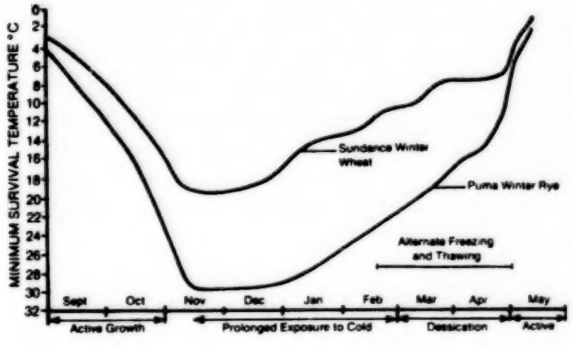


Figure 4. Changes in cold hardiness of winter wheat and rye for the period September to May. The primary factors responsible for these changes are shown at the bottom of the graph. Source: Crop Dev't. Center, U of S, Saskatoon.

If an earlier spring determination of survival is desired, remove a few plants from the field on a warm day. Be careful to protect the plants removed if the air temperature is lower than the soil temperature at the time of removal. If the air temperature is below the plant's minimum survival temperature at that particular stage of winter hardiness, the plants will die. This would lead to a false conclusion as to the extent of crop injury. Bring the excavated plants into a warm area of the house, place the crowns in a moist paper towel (or place in sand, soil, cloth, etc.), cover, and allow to grow. Make sure the paper towel does not dry out at any time. Live plants can be identified in a few days by the presence of new white roots growing from the crown area.

If patchy winter survival occurs, the farmer must assess what amount of survival is acceptable, realizing that the areas winterkilled will likely become troublesome weed patches. When only a few small scattered bare patches exist, some farmers suggest sowing fall rye or winter wheat in these patches as a weed control measure. The winter rye or wheat will stay in a low vegetative state allowing unhindered harvest operations. If many large patches occur, it may be more economical to seed these to spring rye, recognizing the inconvenient harvest situation created by having crops mature at different times.

If damage is extensive and a decision to reseed is made, the surviving fall rye plants should be cultivated out as soon as possible to minimize loss of moisture, tie-up of soil nutrients, and to facilitate early seeding of the spring crop, as well as to minimize the chances of phytotoxic poisoning (plant to plant poisoning) of the new crop. Phytotoxic poisoning is also reduced by seeding immediately after destroying the winter crop and preparing the new seedbed.

Weed control

Control of weeds in fall rye should be considered in the fall. Winter annuals can be controlled effectively with a 300-400 ml per acre application of 2,4-D amine 500, or an equivalent amount of the active ingredient of the esters. Leaving the winter annual weeds to the following spring allows them to become more tolerant, and effective control is more difficult. Summer annual weeds, including wild oats, are not generally a problem in fall rye as it is a strong competitor. However, if stands are thinned through winterkill, herbicides can be applied as with spring cereals, but the time of application will be earlier in the spring and at the three leaf to jointing stage. By early June fall rye is generally in the shot-blade stage and is then susceptible to damage if treated with 2,4-D or related herbicides.

Fall rye should not be grazed in the fall or spring if maximum weed control and grain yield are desired.

For more detailed information on control of specific weeds, consult the latest edition of *Guide to Crop Protection in Alberta* Part 1 Chemical, Agdex 606-1.

Insect control

Do not delay seeding because of grasshoppers. They are active when conditions favor plant growth, but become less active as cold hardening conditions set in. Grasshoppers usually feed on the margins of the field. Delaying seeding may prevent grasshopper damage on these margins, but the whole crop is now jeopardized by winterkill as a consequence of maximum cold hardening not being achieved. What is gained by reducing grasshopper damage is usually lost in reduced yield caused by lower cold tolerance.

Sevin, Cygon and Malathion are registered chemical insecticides for grasshopper control.

Aphids

Aphids very rarely require control in fall rye because they are fairly advanced in their life cycle when the rye emerges. Cygon or Malathion are registered for aphid control in rye.

Sawfly

Wheat stem sawfly can infest fall rye, but never damages it significantly because the rye is almost mature by the time the insect population reaches harmful levels.

Wireworms

Since wireworms move deep in the soil in late August, they do little damage to the emerging crop. In the spring, fall rye growth is advanced sufficiently by the time wireworms become active that the plants generally experience far less damage than occurs in later emerging spring wheat. Therefore, treating fall rye seed with an insecticide is of doubtful value. It is better to reduce the wireworm population by cropping an infested field with treated spring wheat or barley.

Cutworms

When seeding into fallow in years of high cutworm risk, consider delaying seeding until mid-September. The main cutworm egg laying period is from about early August until mid-September. Maintaining a crust over the land during this period will greatly reduce egg laying.

Cutworms may be controlled by spraying with "Ambush" insecticide on the rare occasion when spring cutworm damage is significant.

Diseases

Ergot

Ergot is a common and important disease of rye. Rye is particularly susceptible to ergot because it is mainly cross-pollinated, whereas wheat, barley and oats are mainly self-pollinated. Ergot is caused by a fungus (*Claviceps purpurea*) and can be identified by large, dark purple or black bodies called sclerotia (ergots) which develop in place of the rye kernels. The loss in yield from ergot infection results from the replacement of normal kernels by ergot bodies, and the fungal blighting of normal flowers which fail to form seeds. Further losses are caused by the lower grade received for the grain and the poisonous effect of the grain if fed to livestock.

Ergotism, the disease caused by the presence of ergot bodies in feed, can cause abortion. It is marked in the early stages by irritation and pain in the extremities (tail, ears, feet) and later a dry gangrene sets in. Alkaloids present in ergot have been detected in flour and cereals intended for human as well as animal feed. Any grain containing more than 0.1 per cent ergot is dangerous. This would be 300 to 600 ergot bodies per bushel, or one ergot body per 1,000 kernels of rye. If such feed must be used, the amount of ergot must be reduced through the use of grain cleaning equipment and mixing with ergot-free grain to reduce the ergot percentage below 0.1 per cent. There are no ergot resistant rye varieties. Seed treatment does not prevent ergot.

To reduce ergot infestations the following measures should be taken:

- Use ergot-free seed if possible.
- Rotate with crops resistant to ergot, such as, flax, canola and legumes.
- As the source of ergot infection is often the grass in headlands or ditches, mowing this grass before flowering or seed set will greatly reduce or eliminate the chances of ergot infection.
- Ergots germinate at or near the soil surface to produce infectious spores that attack cereal flowers. To prevent them from germinating, work the field to a depth greater than two inches to bury the ergot bodies.
- Seed at a uniform depth to obtain a uniform early emergence.
- Separate the seed collected from the first few combine rounds to prevent contamination of the entire lot as most of the ergot infested grain will likely be in this region.

Snow molds

Snow mold is caused by one of several fungi that attack the rye plant in the early spring starting

about the time the snow begins to melt. The disease appears as a grey or pinkish web-like mold covering the leaves. Some of these fungi also produce small black bodies about the size of pinheads.

Infected areas normally appear as different sized patches scattered throughout the field. Often only individual plants are attacked. This patchiness occurs because the disease organisms grow under very specific temperatures and moisture conditions; these occur for a long enough period only in individual parts of the field. If single plants are infected, yield losses should be light. If there are many dead patches, losses can be heavy. Yield losses are usually heaviest if there is deep snow and it melts slowly which occurs frequently in the parkland and northern Alberta.

Snow mold fungi increase with frequent winter cereal cropping or perennial forage cropping. Fall rye should never be sown on a field that has just been taken out of a forage crop, because the risk of severe snow mold damage is great. Poor winter survival has often been blamed on the lack of cold temperature tolerance, when, in fact, the damage resulted from snow mold fungi. At present there is no recognized chemical control for snow mold in fall rye.

Ice encasement and drowning are two other common causes of patchy stands, sometimes falsely blamed on a lack of cold temperature tolerance. Therefore, fall rye should only be seeded on fields that are well drained and which do not puddle or pond.

Stem smut

Certain varieties of fall rye are susceptible to stem smut. Cougar has poor resistance, whereas, Musketeer, Prima and Kodiak are rated as good for stem smut resistance. Stem smut can be controlled by treating the seed with a systemic seed dressing. At the present time, the only registered systemic seed dressing is carbathiin (Vitavax).

Plants affected by stem smut can be detected as soon as the crop begins to head, but the disease does not become conspicuous until after the crop starts to ripen. As the name of the disease suggests, masses of black smut spores appear on the uppermost part of the stems. The disease extends into the heads, which also become blackened with smut spores and yield no grain. Heads of infected plants often fail to emerge from the boot and are usually bent or otherwise distorted. Infected stems are much shorter than healthy ones.

Seed decay and seedling blight

Rye is particularly susceptible to seed decay and seedling blight caused by various soil fungi. Various seed treatments will provide protection from these pathogens and markedly increase seedling emergence and plant stands.

Rye is also susceptible to diseases common to other cereals such as common root rot, scald, fusarium blight, powdery mildew and leaf rust, but yield is usually much less affected. Rye severely infected with leaf rust may have higher nitrate levels, making feeding dangerous.

Harvesting and storage

Fall rye shatters very easily when ripe. For this reason it should be swathed when the kernel moisture content is 40-45 per cent. Waiting for the crop to dry down for straight combining results in substantial shattering and a volunteer crop problem.

Recent research results from the Agriculture Canada station at Swift Current showed that fall rye swathed with up to 47 per cent kernel moisture and allowed to field dry (7 to 9 days) suffered no quality loss and graded number one. However, artificial drying of rye grain resulted in downgrading when it was harvested at a moisture content greater than 20 per cent and was further downgraded when harvest moisture levels exceeded 35 per cent. The main downgrading factors were green and immature kernels and low test weight. Therefore, fall rye can be swathed and allowed to field dry without quality loss, but should not be combined and artificially dried until the kernel moisture is below 20 per cent.

Resistance to sprouting is almost nonexistent in our present varieties of rye, and this can result in quality loss problems if wet weather occurs during harvest.

Rye threshes very easily. Under dry threshing conditions care must be taken to adjust the concave setting and/or cylinder speed to minimize cracking. Care in picking up the swath is also necessary to avoid undue shattering.

Fall rye is ready to harvest before other cereals, including winter wheat and early seeded, early maturing barley.

Rye at 14 per cent or lower kernel moisture is considered dry and safe for storage. Normal storage bins used for cereal crops may be used to store fall rye.

Pasture, hay and silage

Fall rye is a very versatile crop when it is used for forage. It can be used for pasture, hay or silage. It can be seeded throughout the spring or summer

and utilized the year of seeding for pasture as well as the following year for pasture, silage or grain production.

Forage production of fall rye may not be as high as for some other cereals, but its ability to withstand grazing, and the winterhardiness of the crop allow it to be used as a forage for more than one year in most areas of the province. The variety Musketeer is more winterhardy than Cougar, Prima or Kodiak.

Fall rye will produce best when grown on fertile well drained soils of medium texture. However, when grown under less ideal conditions such as soils with high acidity, low fertility, or heavy and light textured soils, fall rye will generally outyield other commonly grown cereals.

When grown for pasture, fall rye should be seeded at 55 to 110 lb/acre (drier areas should use a lower seeding rate). The plant's ability to tiller profusely under good growing conditions makes this crop an effective pasture. It can be grazed once the roots are established and a good ground cover has developed through tillering and the plants are six inches high. Fall rye has the ability to make substantial growth under cool temperatures and is suitable for fall and early spring grazing.

Fall rye grows more upright and provides easier and earlier grazing than other winter cereals which have a more prostrate leaf growth. Of the current fall rye varieties, Kodiak has the most upright growth habit.

The nutrient level of fall rye for pasture is excellent. Protein levels will vary with the amount of soil nitrogen and growing conditions, but a dry matter protein content of 18-23 per cent can be expected. At Brooks (irrigated) spring seeded fall rye had a higher protein content throughout the summer than oats, barley or utility wheat. Fall rye sampled the end of October still had a protein content of 22.4 per cent. The fact that fall rye can maintain quality late in the season makes it a good late season pasture.

Fall seeding for pasture

Generally fall rye is seeded August 1 - 15 for good fall grazing. This allows the crop to become established and provide a quality pasture well into the fall. Few forage crops can match the quality and production of fall rye in the fall. Avoid grazing so heavily that the ground is left bare; overgrazing will affect the next year's production, winter survival, and may lead to erosion.

Fall seeded fall rye provides earlier spring grazing than other annual and most perennial pastures. Fall rye works well in pasture rotations for early grazing, until perennial pastures have enough top growth to graze. Fall rye is the most dependable winter cereal for winter survival.

Fall rye, if heavily grazed in the fall or spring, will yield less silage or grain the following year (Figure 5). The effect of fall or spring grazing on seed or silage yields is very dependent on winter conditions, soil type, temperature, moisture levels and fertility. A decision must be made at seeding as to the desired use of the crop. To be safe, if the fall rye is to be used for silage or grain the following year, keep fall and spring grazings to a minimum. The later in the spring the crop is grazed, the more it will yield (Figure 6). Grazing a crop of fall rye as the tillers are approaching the boot stage will greatly affect grain yield. The plant at this time is beginning reproductive growth rather than vegetative growth.

TABLE 2. SPRING GRAZING OF FALL RYE, BROOKS 1983 - 1985.

Date of Clipping	Mean Clipping Yield kg/ha	Summer Hay Yield kg/ha	Grain Yield kg/ha
1st week May	1890	8930	3520
2nd week May	3160	7520	2720
3rd week May	5360	5410	1400
4th week May	6090	5370	1540
1st week June	6050	3310	1115
2nd week June	5560	4910	1830
Control	0	9010	3470

Source: Proceedings of Alternative Crops Conference, Lethbridge, Alberta.
To convert kg/ha to lb/ac multiple by 0.89

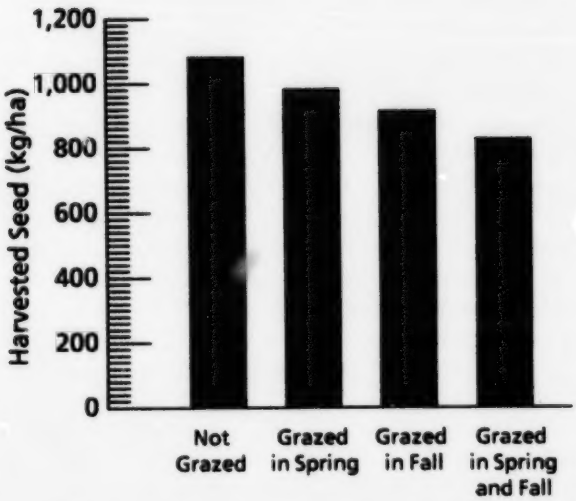


Figure 5. Average effect of grazing on subsequent grain yields. Source: Agriculture Canada Research Station, Swift Current.

Spring seeding for pasture

Fall rye seeded in the spring has the advantage of providing summer and fall pasture in the year of seeding, as well as in the following year. Spring seeded fall rye works well as a rotational pasture. If grazed heavily with a long rest period between rotations, it will yield more than if it were grazed in a short rest rotation or continually grazed. It can be grazed every three to four weeks depending on fertility and rainfall. Research at Swift Current has shown that daily gains in cattle are higher when the fall rye has been grazed less. What fall rye lacks in quantity of production is made up for in quality. Overgrazing at any time will severely reduce the regrowth ability and future production. Early production of spring cereals is higher than spring seeded fall rye (Figure 6), but production of these crops declines rapidly in mid-summer. Adding 25 lb of oats or smooth awned barley to the fall rye may increase the pasture yield early in the season.

In trials at Brooks average yields of fall rye in a simulated pasture rotation under irrigation yielded 3.2 tons/acre (dry matter) of forage. In Lacombe a simulated pasture trial yielded 1.8 tons/acres (dry matter) of fall rye for forage. These yields may not be duplicated in the field since there will be yield losses caused by trampling. Soil fertility, soil type and rainfall will all have an effect on the yield.

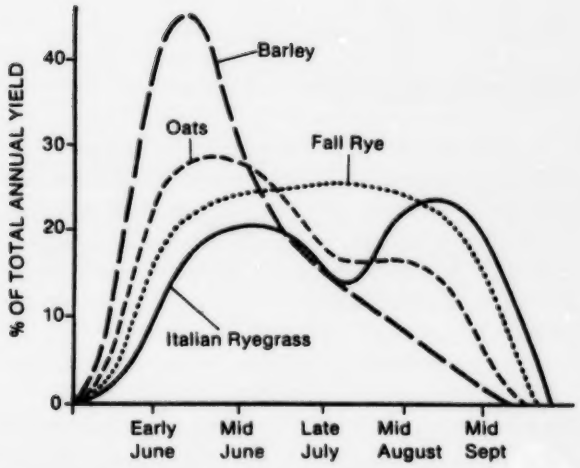


Figure 6. Typical seasonal distribution of pasture yield (1979 - 1983). Adapted from Agdex 120/32-1. Research by Reimer and Gaudiel (1984) and Berkenkamp (1984).*
** Caution — lines do not represent actual yields but indicate typical growth pattern of the crops.*

Interseeding

Fall rye can be spring seeded to oats and barley for silage or grain. Yields of these crops will be reduced by the competitive nature of fall rye. Crops for silage will be less affected since they are harvested earlier and vegetative growth is less affected by competition than in grain formation. The reduction in yield is variable and is dependent on soil moisture, fertility, and soil types. The underseeded fall rye can be used for pasture after the spring crops have been harvested. The amount and quality of rye regrowth is relatively good when used in this manner. If the silage or grain crop is more important than the fall rye for pasture, the fall rye seeding rates should be decreased by one-quarter to one-half the regular seeding rate. However, lowering the fall rye seeding rate will reduce its pasture usefulness.

The spring companion crop chosen will also affect the yield of fall rye for pasture. Oats are generally less competitive than barley and should be considered if the fall rye is important for pasture during the year of seeding. Oats may also have more regrowth than barley when the crop is grazed after harvest, although the competitive nature of the fall rye will greatly affect the regrowth of the other cereal.

The fall rye can be overwintered and used for pasture silage or grain the following year.

Fall rye exhibits greater resistance to diseases such as barley yellow dwarf than other win-

ter cereals when grown in this manner.

Double cropping

Fall rye has been seeded into freshly harvested grain stubble or cereal silage stubble and successfully utilized for fall pasture. If the fall rye is seeded directly into the stubble without cultivation, the stubble will hold the snow and provide better cover during the winter and may improve winter survival.

When following this double cropping procedure, an early maturing spring sown variety should be selected to facilitate early seeding of the fall rye. Double cropping is generally only acceptable for pastures since there will be volunteer grain in the fall rye the following spring.

The success of double cropping is very dependent on soil moisture and weed populations. It may also be advantageous to double crop soils which are susceptible to erosion.

Hay and silage

Fall rye for silage or hay production is ready early in the season if it is not grazed in the spring. This allows the producer to spread out the silage season. If used for silage, the crop should be cut at the heading to early dough stage. For hay crops, the fall rye should be cut at the boot to heading stage. If allowed to become too mature, ergot bodies may be formed in the seed head. These ergot bodies may cause abortions in livestock if in high enough concentrations. If ergot is a problem the feed should be mixed or diluted with other feeds to reduce the concentration. The quality of fall rye for silage is comparable to other cereals, whereas if it is cut for hay past the heading stage, it tends to be of lower quality, coarse and less palatable. When rye is cut late for silage or hay, the protein content decreases and the fibre content increases.

Yields of fall rye for silage or hay are generally lower than yields of oats or barley, but may be higher in areas or years when there is less rainfall.

Fall rye is a winter cereal and has the advantage of utilizing good spring moisture; it resumes growth in the spring as the soil temperature permits. This makes fall rye an attractive crop for silage or hay on sandy soils or in drier areas of the province.

Grazing and feeding problems

Nitrate poisoning can be a problem when grazing or feeding fall rye silage or hay if the crop has been stressed by frost, drought, hail or plant diseases which can cause a nitrate accumulation in the plant. This accumulation may become high enough to be toxic in livestock. The risk of nitrate poisoning will increase if the crop has been fertilized with high rates of nitrogen. It should not be fertilized at rates higher than normal grain crops, unless the livestock are intensively managed.

Producers should be cautious if grazing or feeding fall rye that has been under severe stress. Livestock should be removed from the pasture or the silage or hay restricted until the feed has been analyzed. Nitrate levels in the feed over .35 per cent to .45 per cent are considered potentially toxic. This high nitrate feed may be mixed with safe feed to reduce the risk. If nitrate levels are abnormally high in a pasture, take care to see that the fall rye is not the sole feedstuff. Animals can be fed grain or other high quality feeds prior to pasture exposure each day.

Grass tetany is another problem which may arise when grazing fall rye or other lush growing pastures, especially when heavily fertilized with nitrogen and potassium. This condition is caused by low levels of magnesium in the animal's blood. Even though the herbage may contain adequate levels of magnesium, absorption may be low if there is an imbalance of other minerals. Grass tetany may be a risk if the ratio of potassium (K) to calcium (Ca) and magnesium (Mg) in the herbage is greater than 2.2. Fertilizing pastures with magnesium or feeding magnesium may reduce the risk. This condition can be recognized by nervousness and twitching by the animals; in the later stages the animal may stagger, go down on its side and go into convulsions. If this problem arises, work closely with your veterinarian.

Fall rye as pasture is less palatable than other cereals. If given a choice, livestock may graze other crops, but if not, the livestock will readily graze the fall rye. Fall rye pastures may be separately fenced to avoid giving the livestock a choice. Palatability is generally not a major problem.

The adaptability, versatility and quality of fall rye make it an attractive crop to grow for livestock forage. It allows the producer flexibility while maintaining a high quality forage program.

Feeding rye grain to livestock

Rye can be a highly nutritious, economical feed grain for livestock, but it has not always been popular with livestock producers or feed compan-

ies. Although some of their reasons for this discrimination are valid, most are unfounded. Admittedly, rye is less palatable to most livestock than other grains and is more susceptible to ergot. However, this can be allowed for when setting up the feeding program or ration.

While it is important to be aware of the danger of ergot contamination, it should not be used as an excuse to condemn rye as feed. Most rye does not have enough ergot (see ergot in disease section) to be harmful, and when it does it can be cleaned and/or diluted to safe levels.

Rye is similar to barley in its average nutritive content. It has about 12 per cent protein, 2.5 per cent fibre, 76 per cent TDN for cattle and 3330 kcal/kg digestible energy for pigs. It has a little less energy content than wheat or corn but more than oats. Its protein content is lower than that of wheat. As with other cereals, rye's nutritive content varies with growing conditions.

Rye appears equal or slightly superior to barley in livestock rations but using it to replace wheat has resulted in lower performance.

In research trials dairy rations containing 40 or 60 per cent rye were fully equal to barley rations with respect to daily consumption and milk production.

In trials with finishing steers, rations containing 60 per cent rye were equal to rations containing the same amounts of barley. In Manitoba tests with beef steers rye was successfully used to replace all of the cereal; beef steers gained 2.86 lb/day.

In trials with growing-finishing pigs, replacing up to 30 per cent of the barley with low-ergot rye did not significantly reduce performance. Pelleting rations containing rye helped to reduce the depression in average daily gains that occurred when higher levels of rye were fed. Rye is not recommended for piglets.

Studies at Kentville, Ontario showed that rye can replace up to 10 per cent of the wheat in broiler-finisher diets, with similar results. Higher levels reduced performance as wheat is higher in energy than rye. Diets for pullets, layers and breeder flocks can contain 10 to 20 per cent rye, but it is not recommended for young chicks as it may cause watery droppings and pasty vents.

Although the evidence shows that rye is at least equal to barley in energy value when fed as part of the diet, animals often eat less when rye is the only grain, and so performance suffers. This is generally attributed to a lack of palatability. Animals don't like the taste of rye as much as other grains. This is not a serious problem in most cattle or sheep rations as concentrates as well as other grains. Also, as beef cattle are often not fed for maximum grain intake, any effect on daily intake is not noticeable.

The palatability of rye is a greater problem with pigs and poultry. Rye should be analysed by a reputable feed laboratory and the ration formulated according to the results.

Appendix I
Recommended Varieties of Fall Rye (1988)
(Varieties described in order of winter hardiness)

Musketeer — was developed at the Agriculture Canada Research Station Swift Current and registered in 1980. It has the highest winter hardiness of our current varieties, and yields about 7 per cent higher than Kodiak depending on the growth area of Alberta. Large long kernels, good 1000 kernel weight, very good straw strength, stem smut resistant, early maturity and good shelling resistance also characterize this variety.

Cougar — was developed by the University of Manitoba and registered in 1967. It has short strong straw, matures two days later than Musketeer, has good winter hardiness, medium kernel size and good 1000 kernel weight. Cougar is the most stem smut susceptible variety and yields 2-5 per cent less than Kodiak.

Prima — the newest variety, registered in 1984, developed by Agriculture Canada, Swift Current. It is higher yielding than Musketeer by 3-4 per cent, matures about one day later and is more susceptible to lodging. Seed size, test weight and plant height of Prima are similar to Musketeer.

Kodiak — currently the most popular fall rye variety in Alberta, developed at the University of Alberta and registered in 1971. It yields about 7 per cent less than Musketeer and up to 10 per cent less than Prima.

It matures two days later than Musketeer, has weaker straw strength and poorer test weight but is equal in stem smut resistance to Musketeer. It will likely be replaced by Prima as more seed becomes available.